4.11 GEOLOGIC RESOURCES

This section describes the physiographic and geologic setting, faults, seismicity, and other geologic considerations and resources in the vicinity of the proposed Cabrillo Port Liquefied Natural Gas (LNG) Deepwater Port (DWP), including associated offshore and onshore pipelines (the Project), and addresses concerns raised during the scoping period regarding erosion, tsunamis, and seismic activity. Potential ways for geologic hazards to impact the Project are identified, as are potential Project impacts on geologic resources. Additionally, the proposed alternatives' geologic implications are evaluated relative to the Project.

Mineral resources and associated impacts are discussed in Section 4.10, “Energy and Minerals.” Additional descriptions of erosion and sediment impacts on the environment, e.g., turbidity, and other mitigation measures to be taken are presented in Section 4.18, “Water Resources and Sediments.”

4.11.1 Environmental Setting

This section describes the physiography, geology, and associated geologic hazards in the vicinity of the Project site.

4.11.1.1 Physiography

The Project and alternatives are situated in both the onshore and offshore part of the Transverse Ranges Physiographic Province and the offshore Peninsular Ranges Physiographic Province of the State of California. The Transverse Ranges are characterized by a predominantly east-west trending system of faults, folds, and mountain ranges. The Peninsular Ranges are characterized by northwest trending ridges and mountain ranges separated by basins and faults.

The proposed Project is situated within the Ventura and Santa Monica basins. The Ventura Basin is bounded on the north and south by major regional faults. The Santa Ynez Fault forms the northern structural boundary while the Santa Monica Fault system forms the southern structural boundary. The Project comes ashore at Ormond Beach, a relatively wide beach, typical of the Ventura County coastline whose shoreline is relatively flat and slopes in a southwesterly direction at 0.13 to 1.3 percent.

Onshore, the Project is on the coastal margin of the Oxnard Plain, which occupies the southwest part of the older buried Ventura Basin. The Oxnard Plain is broad and relatively flat, with a southwesterly slope (at approximately 0.2 to 0.3 percent) that rises from the sea level to an elevation of approximately 150 feet (45.7 meters [m]) near South Mountain. The Line 225 Pipeline Loop and its Alternative are located near the eastern boundary of the Ventura Basin in a tributary valley (the Santa Clarita Valley) that is drained by the Santa Clara River. From milepost [MP] 0.0 to 2.0 the loop traverses relatively rugged terrain, while the remaining pipeline is in a relatively flat valley floor.

The offshore Project, located in the northeastern part of the Santa Barbara Channel, is on the Hueneme-Mugu Shelf (the offshore extension of the Oxnard Plain), the Hueneme-Mugu Slope and the Santa Monica Basin (Figure 4.11-1). The Hueneme-Mugu Shelf varies in width from less than 0.9 nautical mile (NM) (1 mile or 1.6 kilometers [km]), west of the Mugu Submarine Canyon to about 3.5 NM (4 miles or 6.4 km) east of the Hueneme Submarine Canyon. Slopes on the shelf are gentle, less than 0.5 to slightly over 1 degree, and generally to the southwest (Figure 4.11-1).

The Hueneme-Mugu Shelf is dissected by a series of submarine canyons, between the Hueneme and Mugu Canyons. These canyons and intervening slopes represent the Hueneme-Mugu Slope. The pipeline route has been planned to follow the more gentle slopes along ridges between steeper canyons. The ridge slope along the proposed route ranges from about 2.5 to 6 degrees. The side slopes into the valleys on either side of the proposed pipeline route are noticeably steeper. Adjacent to the ridge slope, the side slopes of the valleys are about 15 to 20 degrees (Figure 4.11-1). With the exception of the Hueneme and Mugu Canyons, which cut into the shelf to near the shoreline, the transition between the Hueneme-Mugu Shelf and Hueneme-Mugu Slope generally occurs at an approximately 180- to 200-foot (55 to 61 m) depth.

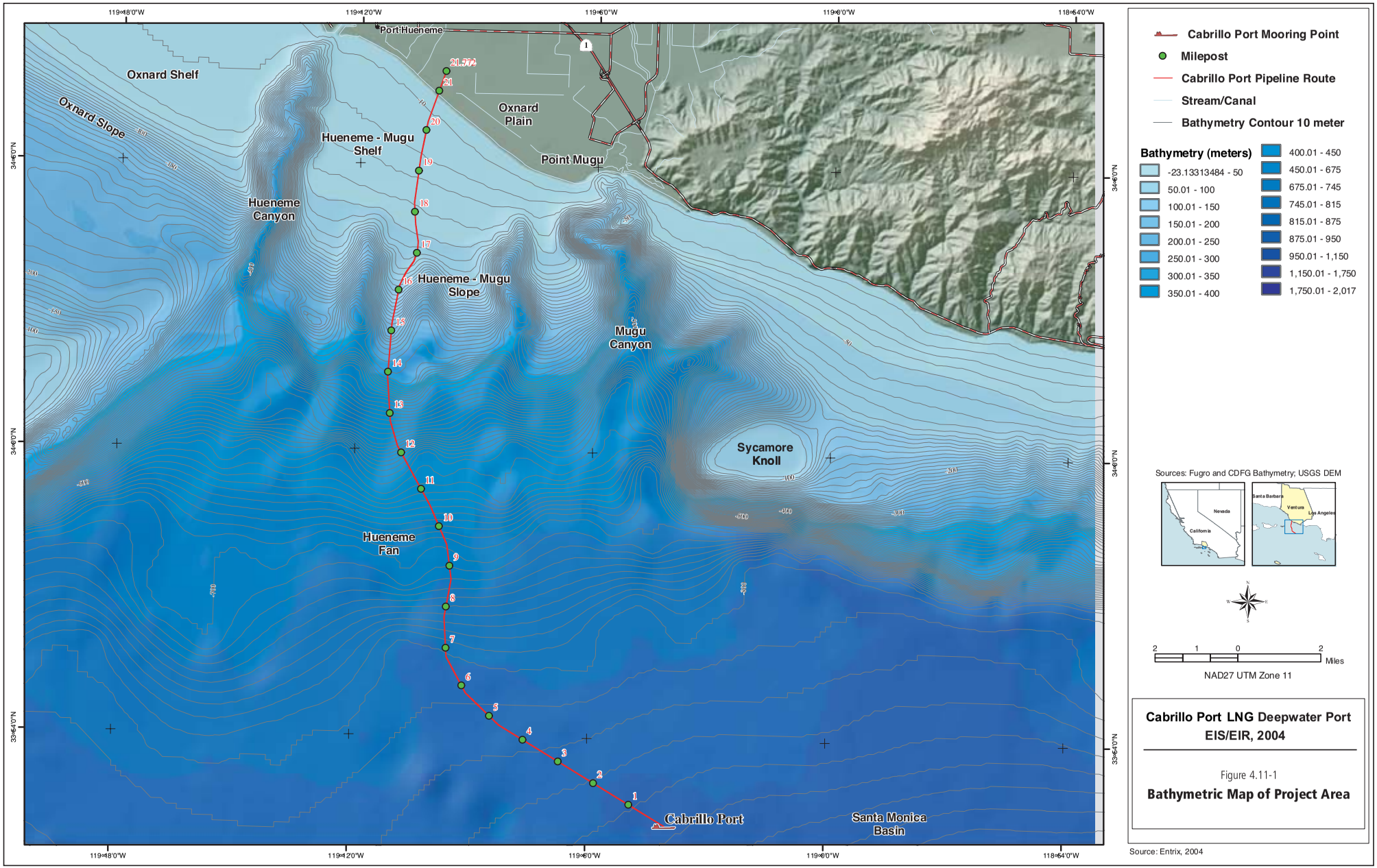
The base of the canyons opens up to the south into the Santa Monica Basin, where ongoing sediment deposition from the canyons forms the Hueneme Fan. The slope of the Hueneme Fan in the vicinity of the Project ranges from about 3 degrees near MP 12 to less than 1 degree near the Project floating storage and regasification unit (FSRU) location (Figure 4.11-2).

4.11.1.2 Geology

Lithology

Nonmarine fluvial, deltaic and lagoonal, and nearshore marine deposits associated with the prehistoric delta of the Santa Clara River and Calleguas Creek form the surface and near-surface deposits of the Oxnard Plain and offshore shelf areas (Weber and Kiessling 1976; Sprotte and Johnson 1976 as reported by Entrix August, 2003). Only surficial deposits are expected to be encountered in the Project area because the facilities will only be located on the sea floor, the surface, or shallow subsurface. The Miocene and younger deposits are described below:

Miocene Rocks: Miocene rocks consist of both sedimentary and igneous rocks. Miocene sedimentary rocks have been divided into lower, middle, and upper sedimentary strata. The lower Miocene strata consist of two formation units, including: (1) the lower shallow marine sandstones with lesser conglomerates, siltstones, and mudstones of the Vaqueros Formation; and (2) the upper claystones, mudstones, siltstones, and subordinate sandstones of the Rincon Shale. The middle Miocene strata consist of typically siliceous, diatomaceous, tuffaceous, phosphatic, or bituminous laminated shales and are associated with subordinate sandstone, siltstone, chert, dolomite, limestone, and bentonite. The upper Miocene strata consist of diatomaceous mudstone, claystone, siltstone, and sandstone of the Sisquoc Formation. Upper



Cabrillo Port LNG Deepwater Port EIS/EIR, 2004

Figure 4.11-1

Bathymetric Map of Project Area

Source: Entrix, 2004

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